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THE DRIFT OF NORTH POLE 7 AFTER ITS ABANDONMENT

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THE RUSSIAN ice-floe station, North Pole 7, was abandoned on 11 April 1959 at 85° 14′ N, 33° 03′ W, or about 70 nautical miles north of Cape Morris Jesup, Greenland. Two years later, on 9 April 1961, the remains of it were seen and photographed by the R.C.A.F. at 70° 28′ N, 67° 30′ W, or about 16 miles east-southeast of Cape Christian, Baffin Island.

The abandoned station was frozen into the fast ice near the edge of a very large polar floe. It seems probable, however, that this floe was formed by the freezing together of a number of others and did not represent the original floe of the floating station. The opinion of an experienced ice observer, Lt. W. A. Dotson, U.S.N., who saw it in both winter and summer conditions, is that the only part of the original floe remaining was the area actually covered by the NP 7 buildings. From the photographic evidence, which is not very extensive, I tend to agree with this view. The report of a Department of Transport ice observer who accompanied the R.C.A.F. flight states that the fast ice extended for 12 miles seaward from the position of the station, that the ice in the area was 80 per cent polar, 20 per cent winter, and that there was heavy ridging. Nine icebergs were counted within a 15-mile radius of the station, and there was an ice island 2 by 5 miles in extent lying 40 miles north of Cape Christian, as well as a small "possible ice island" about 10 miles southwest of NP 7.

On 21 May a landing was made at the station by an R.C.A.F. Dakota carrying two Defence Research Board scientists, who found a note left by the officer in charge, N. A. Belov, and a variety of huts, tents, food, and equipment. Mr. Belov's note dispelled any doubt that the station was in fact NP 7. The buildings were perched on pillars of ice and from these it was estimated that about 10–12 feet of ice had been lost from the surface by ablation since the floe was abandoned. How much increment there had been on the bottom in the same period is not known, and no measurement was made of the thickness of the floe. When first occupied in 1957 the floe was described as of uneven thickness varying from 2.1 m (7 ft) and 6 m (19.5 ft),[1] and it may be that a rough estimate of 6 feet made by one of the landing party was fairly close.

ALTERNATIVE DRIFT ROUTES

The question of how the floe found its way from the Arctic Ocean to Cape Christian is of some interest. There are two possible routes (Figure 1): a short one through Robeson Channel to Smith Sound and Baffin Bay, and a long one down the east coast of Greenland and then up the west coast with the West Greenland Current and across Baffin Bay. These are referred to as the west route and the east route respectively.

The distances involved are about 1,035 nautical miles for the west route and 3,100 for the east route and the time is from 11 April 1959 to the date of freeze-up of the fast ice at Cape Christian in 1960, which I have taken to be 15 December. We have no exact information on this date, but a DOT ice reconnaissance on 19 November showed fast ice just beginning to form in northern Home Bay, about 100 miles farther south, and it would take some time for it to grow out 16 miles. The date may even be too early. Thus 614 days may be estimated as the total period of drift, which in turn gives an average speed of

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ED. NOTE: Since the presentation of this paper to the annual meeting of the C.A.G./A.C.G., McMaster University, Hamilton, Ont., on June 1, 1962, an article on North Pole 7 by Z. M. Gudkovich and L. L. Balakshin, which comes to exactly the same conclusions, has appeared in *Priroda*, no. 6 (June 1962).

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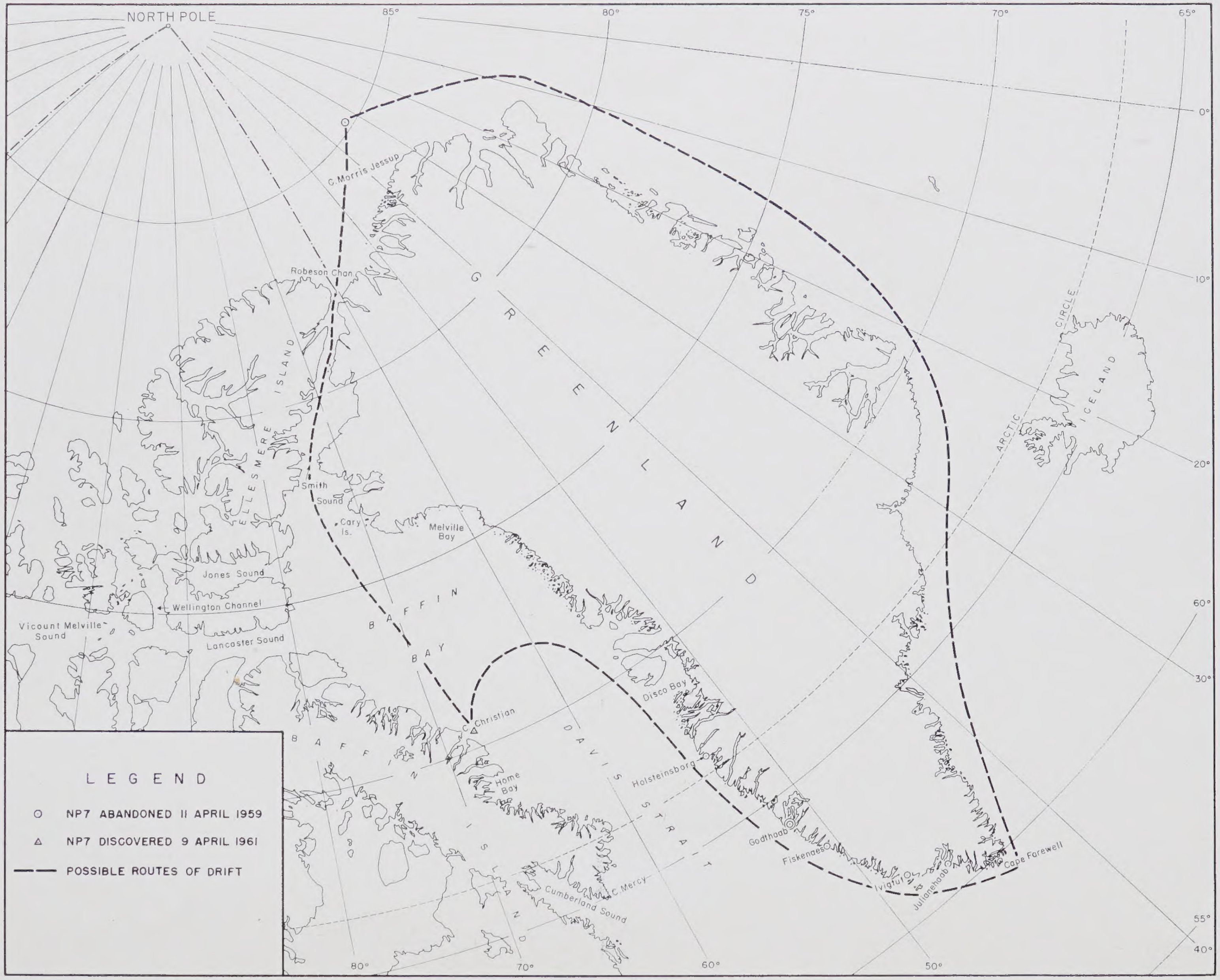

FIGURE 1: Map showing the possible alternative routes taken by North Pole 7 after it was abandoned.

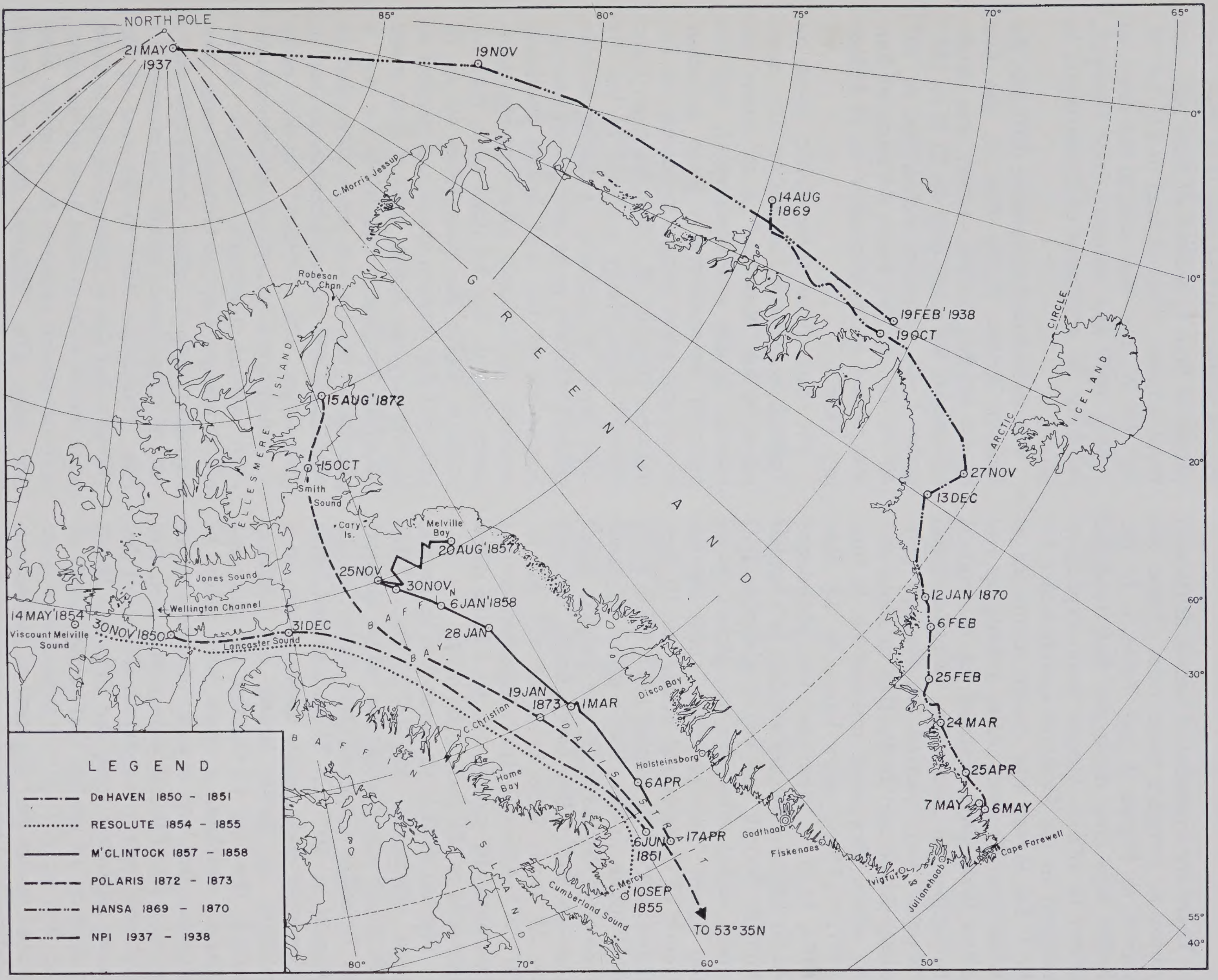

FIGURE 2: Known drifts in the areas in which North Pole 7 may have drifted.

1.7 miles per day for the west route and 5.0 miles per day for the east route.

PREVIOUS DRIFTS

There are a number of known drifts with which to compare these rates. These are shown in Figure 2 and Table I. In the Baffin Bay area there are four recorded drifts. In 1850 a United States expedition engaged in the Franklin search under Lt. E. J. De Haven was caught in the ice in Wellington Channel. After drifting up and down Wellington Channel till the end of November the two ships "Advance" and "Rescue" were carried out through Lancaster Sound and Baffin Bay to about 66° N, where they were released on 8 June 1851.[2,3] Three years later, on 14 May 1854, H.M.S. "Resolute" was abandoned on Sir Edward Belcher's orders in Viscount Melville Sound, and began a similar drift which ended when she was picked up by the whaler "George Henry" near the entrance to Cumberland Sound on 10 September 1855.[4] In August 1857, Capt. F. L. M'Clintock in the "Fox" failed to reach Lancaster Sound and was carried south through Baffin Bay to be finally released on 25 April 1858 at about 63° 40′ N, 59° W.[5] After 17 April, however, he was intermittently under sail, so I have taken this date as the end of the drift.

The last drift in this area was by far the most dramatic. In 1872 the U.S.S. "Polaris," after leaving her winter quarters in Robeson Channel, was beset on 15 August at 80° 02′ N and drifted, with occasional short spurts under power, to a position in Smith Sound off Littleton Island. Here on 15 October the ship was almost wrecked, a start was made to abandon her, and a party of nineteen, including two Eskimo women and their five children (one a two-month-old baby) became separated from the ship and began a drift on an ice-floe that carried them all the way to 53° 35′ N before they were picked up by the "Tigress" of Newfoundland on 30 April 1873.[6]

For the east Greenland area there are two known drifts. The first was in 1869, when the "Hansa," one of the ships of a German expedition under Karl Koldewey, became beset at 74° 45′ N, 13° 56′ W on 14 August. On 21 September the "Hansa" sank, and the party, under Capt. P. F. A. Hegemann, continued their drift south on the ice, like the "Polaris" party but with the important differences that they had plenty of time to unload all their gear and build a house. They drifted to 61° 04′ N, 42° 30′ W, and then took to the boats on 7 May 1870 and rounded Cape Farewell, reaching the settlement of Frederiksdal in safety.[7]

The second east Greenland drift was the famous station North Pole 1, the first Soviet ice-floe station, which was established near the north pole on 21 May 1937 under I. D. Papanin, and drifted to 70° 40′ N, 19° 16′ W, where the party of four was picked up by icebreaker on 19 February 1938.[8]

The data from these drifts, given in Table I, is of varied reliability. The exact route of the "Resolute" is of course not known, as she was unoccupied, and the place of her recovery is given in rather broad and often perplexing terms, as for instance "Lat. 67 N, 20 miles from Cape Mercy." Cape Mercy is at 65° N, but the cape itself is probably a fairly reliable guide. De Haven gives only a very sketchy description of his drift in his published account, particularly after leaving Lancaster Sound, but he does state that his track in Baffin Bay was from 40 to 70 miles off the western shore and parallel to it. His surgeon, Kane, adds a little more detail in his diary, but while he was a good observer he was more interested in physiology and auroral phenomena than in drift rates. The "Polaris" ice-floe party were hampered by lack of instruments and even writing materials, but the senior officer present, Captain George Tyson, contrived to keep a rather remarkable diary which gives some useful information. I have placed his drift to the east of De Haven's, but this is rather arbitrary as both were out of sight of land most of the time, with occasional glimpses of it on the west side only. The "Polaris" floe may have been farther west than I have placed it. The "Hansa" party were well equipped and published good records; thus the positions they give are presumably reliable. The North Pole 1 data also must be regarded as good, though I have not been able to

TABLE I

KNOWN DRIFTS THROUGH BAFFIN BAY AND DOWN THE EAST COAST OF GREENLAND

Baffin Bay Area

Drifting station	Positions		Dates of drift	Direct distance (nautical miles)	No. of days	Rate in nautical miles per day
	start	end				
De Haven						
Lanc. Sd.	7440,9210	7420,8000	30/11/1850-31/12/1850	195	31	6.3
Baffin-Davis	7420,8000	Davis St. c.6600N	31/12/1850—8/6/1851	665	159	4.2
Total	7440,9210	Davis St. c.6600N	30/11/1850—8/6/1851	860	190	4.5
"Resolute"	7441,10122	6445,6230 (app)	14/5/1854—10/9/1855	1100	484	2.3
M'Clintock	7517,6216	6528,5824	20/8/1857—17/4/1858	760	240	3.2
"Polaris"						
ship	Kane B. at 8002N	Smith Sd. at 7221N	15/8/1872—15/10/1872	113	61	1.8
ice floe	7221N	5335N off Labrador	15/10/1872—30/4/1873	1580	198	8.0
Total	8002N	5335N	15/8/1872—30/4/1873	1693	259	6.5
East Greenland						
"Hansa"	7445,1356	6104,4230	14/8/1869—7/5/1870	1070	266	4.0
NP 1						
Total	8925,7840	7040,1916	21/5/1937—19/2/1938	1200	274	4.4
from 8248N	8248,0700	7040,1916	19/11/1937—19/2/1938	770	92	8.4
NP 7						
NP 7						
west route	8514,3303	7028,6730	11/5/1959—15/12/1960	1035	614	1.7
east route				3100		5.0

consult a copy of the scientific report and have had to use popular and secondary sources.

By far the most information is given by the meticulous M'Clintock, whose route can be followed in some detail, and who made an analysis of his drift, relating it to wind force and direction. It is interesting to note that although the prevailing winds remained northwesterly throughout the period of the drift, the ship persisted in a general westward movement until the end of November, when it finally settled on a southeasterly course. It would appear that the current swinging west from Melville Bay must be strong enough to override the wind influence. A similar phenomenon was noted by Tyson, who, though lacking M'Clintock's training, was a good observer and an experienced seaman familiar with the region. He observed that after they came out of Smith Sound, although the winds were northwesterly, the floe seemed to be drifting somewhat west of south. As he had no compass he was going only by the built-in direction-finder of the sailor, but it seems he must have been right, as they later had sightings of land on the west side and never approached within sight of the Greenland coast.

Table I shows a very marked variation in drift speeds, which cannot be wholly attributed to the unevenness of the data. There is a considerable variation not only between one channel and the other, but also between drifts in the same area. Most of the rates are higher than those of drift stations in the Arctic Ocean, which have been mainly between 0.4 and 2.0 miles per day.[9] This probably reflects stronger currents and in some cases the funnelling effect of wind in narrow channels. Over short periods some very high drift speeds were recorded by M'Clintock and Hegemann. M'Clintock's highest speeds were an average of 9.9 miles per day for the first 17 days of April, and 39 miles in 48 hours in a March gale. The "Hansa" floe drifted at 14 miles per day for four days in January and for "the first few days of February" (exact number not stated) reached the impressive record of one knot, or 24 miles per day.

In Table II the Baffin Bay drifts are broken down by area to give a closer comparison with the west route. The "Resolute" drift is omitted because of insufficient detail, and the "Polaris" data is based merely on a sighting of the Cary Islands on 8 November and the return of the sun on 19 January, which would place them at about 70° N. Terminating the drifts at this latitude gives a more valid comparison with NP 7, because all three parties experienced a marked increase in speed in Davis Strait south of this latitude, due perhaps mainly to an increase in current rate and in wind speed (this latter is certainly true of M'Clintock's drift) but also to some extent to the opening out of the ice toward the outer edge of the pack. The much higher speed of the "Polaris" floe compared with De Haven's ships over much the same track is probably a reflection of wind differences. Tyson experienced a stormy winter with prevailing northwesterly winds, whereas De Haven seems to have had fewer storms, and a greater proportion of them were from the southeast. M'Clintock, like Tyson, had strong northwesterlies, and yet his speed is very similar to De Haven's. One factor contributing to this may be the fact that the "Fox"'s track lay near the centre of the channel, where the current is probably less marked. In this connection M'Clintock noted that in the northern part of the bay the ship's head turned round very slowly from NNW to W, from which he deduced that they were probably drifting more slowly than the ice to the west of them. About 72° N the ship's head slowly shifted back to WNW, suggesting that they were then drifting faster than the western ice.

Even the slowest of these figures is about twice the over-all figure calculated for NP 7 by the west route. This however is not surprising, as they do not take into account the initial Arctic Ocean part of the route. The speed of movement for this area is an entirely unknown factor, but it is likely to be much lower than the average of 1.7 miles per day, as it is an area of indefinite currents. The rate of drift of the ice island T3 between the north pole and the coast of Ellesmere Island is the nearest likely comparison, and it averaged only 0.4 miles per day on a straight-line course.[10] Furthermore, if the floe came this way it must either have remained in

TABLE II

Rates of Drift over West Route to 70° N

Station	Positions		Dates	Distance in nautical miles	No. of days	Rate in nautical miles per day
	start	end				
De Haven	7420,8000	6940N	31/12/1850—26/4/1851	420	116	3.6
M'Clintock	7502,7022	6950,5943	25/11/1857—1/3/1858	368	95	3.9
"Polaris" (floe)	Cary Is. (7645N)	7000N	8/11/1872—19/1/1873	460	72	6.4
"Polaris" (ship and floe)	8002N	7000N	15/8/1872—19/1/1873	680	157	4.3

the Arctic Ocean throughout the winter of 1959–60, or wintered over somewhere between Robeson Channel and Smith Sound, as this channel is to all intents and purposes frozen fast in winter. If we assume that it wintered at about 80° N and that the ice here broke up about 20 July, which is approximately accurate according to available ice charts,[11,12] then the rate of drift for the rest of the journey would be 4.2 miles per day. If it did not start the journey down Robeson Channel until break-up 1960, we get a rate of about 5.3 miles per day. Both these rates seem quite reasonable. The first is almost exactly that of the "Polaris" from 80° 02′ N to 70° 00′ N (4.3 miles per day). The second, which is higher, is actually rather more probable, as the "Polaris" drift as far as Smith Sound was in close pack ice, whereas in 1960, which was in general a very open year, conditions were favourable for a more rapid drift over this part of the route.

Turning to the east route, the calculated speed for NP 7 is somewhat higher than that of the "Hansa," which however kept so close to shore that a good deal of slowing due to shoreline drag might be expected. The over-all speed of NP 1 is also rather slower, but for the part of its route which more or less coincides with that of

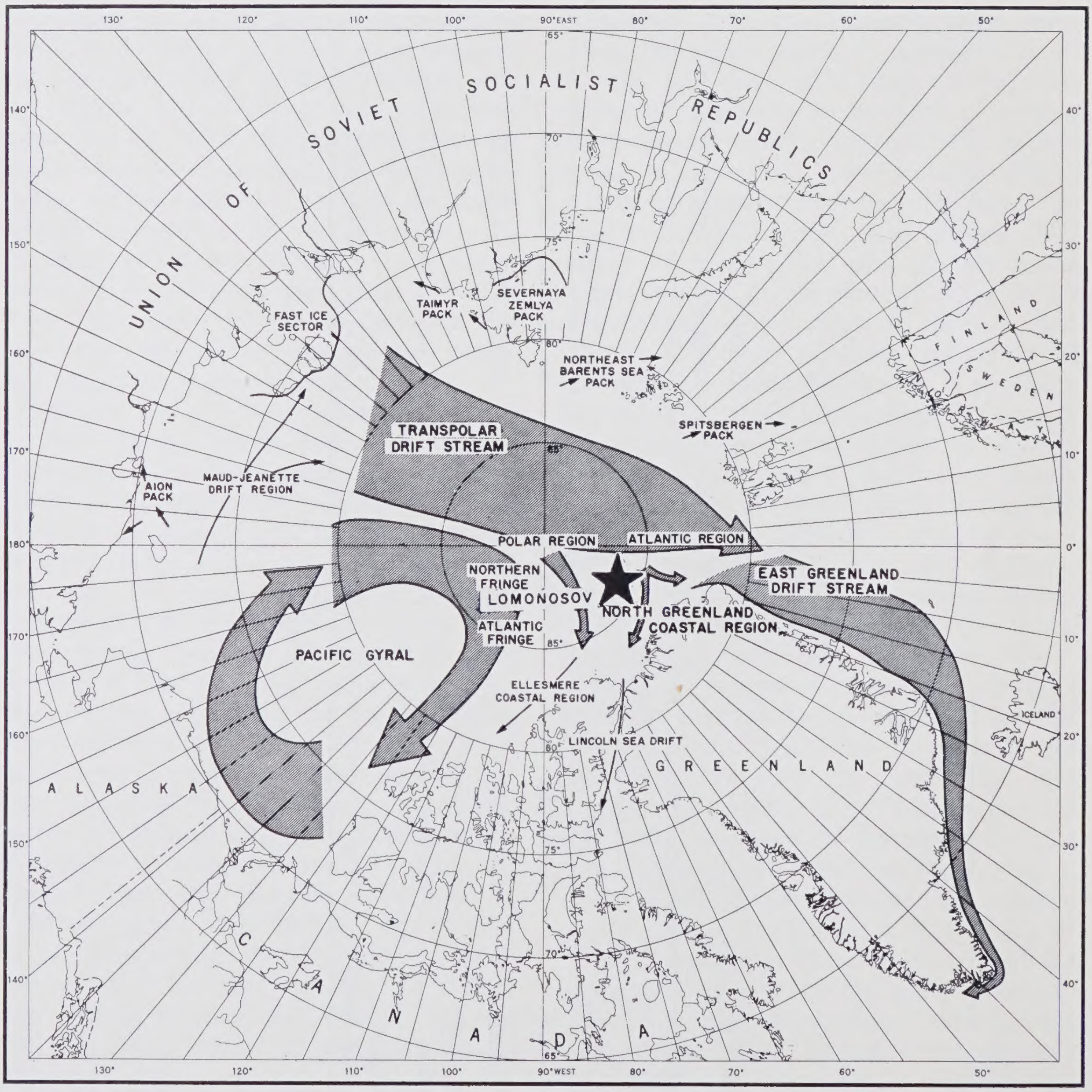

FIGURE 3: General drift pattern in the Arctic Ocean (from Wittmann, Senior, and Skiles, 1961). ☆: Position of NP 7 when abandoned.

NP 7 its average is much higher. Drift rates up the west coast of Greenland as far as Godthaab can be estimated from the observed movement of the ice. These are also high—over 7 miles per day.[13] Farther north, movement would be slower, but it is clear that there would have been enough time available for the floe to come by the east route and that the evidence of drift rate is insufficient to form any conclusions.

DRIFT PATTERN AND WINDS AT POINT OF ABANDONMENT

The general drift pattern of ice in the Arctic Ocean is shown in Figure 3.[14] It will be seen that the position of abandonment of NP 7 is quite critical, and that the floe was almost equally likely to go either way. This map actually places it squarely in line for Robeson Channel, but it would be a mistake to put too much weight on this fact as the map is highly generalized, and another version might give the opposite impression. Furthermore this is a portion of the Arctic Ocean which is relatively little known.

Some indication of the probable path of NP 7 can be gleaned from the mean pressure charts. Table III shows the monthly direction of drift according to the 30-day mean charts, and Figure 4 shows a very rough estimate of the possible course of the ice floe, assuming isobaric drift and an arbitrary average speed of one mile per day except in months where light winds are indicated, when the speed has been reduced by half. The fact that this track heads directly into the middle of Robeson Channel is pure coincidence and not the result of manipulation of the distances or directions. This is not put forward as in any way a reliable estimate, but there are nevertheless two interesting points that emerge. The first is that if the assumed track and drift rate are anywhere near accurate and the floe did take the west route, then it did not reach Robeson Channel until well on into 1960. The second is that it had only to move at a rather faster rate for the first three months or so to be caught up in the East Greenland Drift and thus be committed to the east route before the change of winds from westerly to easterly in August. Even though the pressure charts for April, May, and July indicate very light winds, this possibility cannot be ruled out, and Table III shows that once in the East Greenland Drift the floe would have no trouble maintaining a high southward drift rate. Thus analysis of the weather data suggests, but does not prove, that the west route was taken.

TABLE III

Monthly Drift Direction of NP 7 according to the 30-day Mean Pressure Charts

Month	Direction	
	West route	East route
2nd half April 1959 (15-day chart)	S (light)	S (light)
May	SE (light)	SE (light)
June	SE	SE
July	SE (light)	SE (light)
August	SW (light)	S
September	S of W	S of W
October	WSW	WSW
November	SSW	S
December	SE (light)	SSE (light)
January 1960	S of W	SW
February	S of W	SW
March	SW	SW
April	W	SW
May	SW (very light)	S (light)
June	SW	W

ICE CONDITIONS IN BAFFIN BAY AND DAVIS STRAIT

Let us now turn to local ice conditions in Baffin Bay and Davis Strait and on the west coast of Greenland. These have been under observation long enough to be fairly well known, and there are records available for the actual years concerned.[11,12,15]

Figure 5 shows the average limit of one-tenth concentration of sea ice throughout the break-up season from its maximum in March-April. It will be seen that even at the height of winter the pack ice extends down the coast of Greenland only about as far as Holsteinsborg, and that during break-up a tongue of open water thrusts northward up the Greenland coast, leaving the west side of the bay to clear last. This is due to the presence of a warm current up the coast of Greenland and a cold one down the coast of Baffin Island. At the

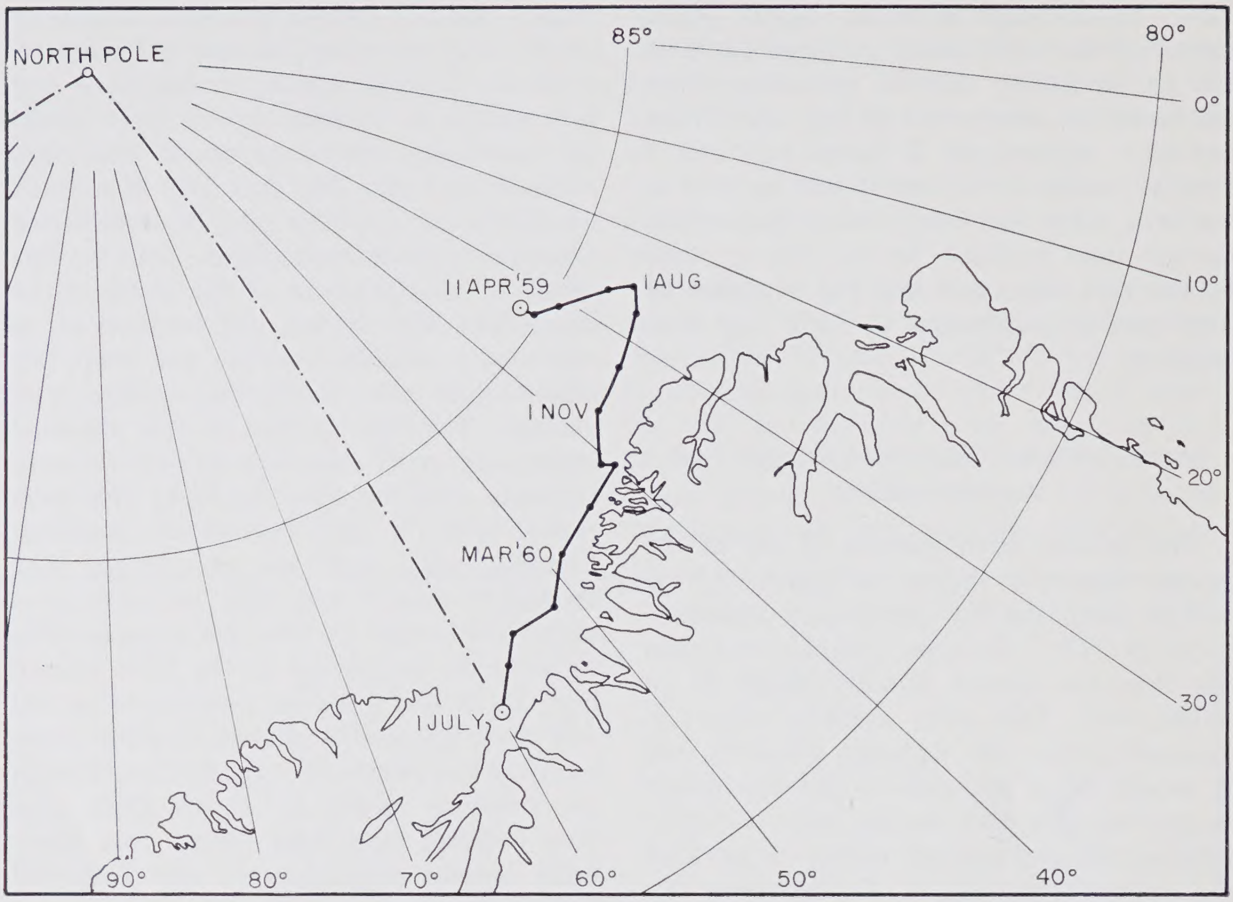

Figure 4: Possible course of NP 7 based on monthly mean pressure and an arbitrary drift rate of ½–1 mile per day.

same time the open water of Smith Sound, the North Water, is spreading southward, leaving the northern part of the bay clear until the ice breaks up north of Smith Sound and begins to drift south. Much of this ice, which is predominantly polar, melts in the warmer water of Baffin Bay, but toward the end of September melting becomes less and some of the polar floes survive into the winter. Note that in September Baffin Bay normally becomes clear of ice.[16,17] This means that all the locally formed ice melts every year and that any polar ice found in the bay in winter must have come from elsewhere, mainly Smith Sound. It is safe to say that in recent years no polar ice has come from Lancaster Sound except possibly early in the season, and the contribution of Jones Sound is also probably negligible.

Some polar ice comes round Cape Farewell with the East Greenland Drift, as shown on Figure 5. This is known as the "storis," which means "big ice" in Danish, and it has been studied for over one hundred years by the Danes. It is with this ice that NP 7 would have to travel if the east route was used. The storis normally passes Cape Farewell late in January and moves north up the coast, reaching Julianehaab in February, Fiskenaes in April, and sometimes as far as Godthaab in May.[13] Even before the start of the recent warming trend it seldom went north of Godthaab, and the reason it gets no farther north is partly that it cannot survive the high temperatures of the West Greenland Current and partly that there is a strong offshore drift into the Labrador Sea which tends to dissipate it.

An excellent set of ice charts from the new air reconnaissance service set up by the Danish Meteorological Institute shows that in 1960 the storis reached no further than Ivigtut.[15] There is thus a distance of over three hundred miles of open water which NP 7 would have to have crossed, with water temperatures varying from about 1.6° C in May to 5.5° C in August,[18] to reach Cape Christian by the east route.

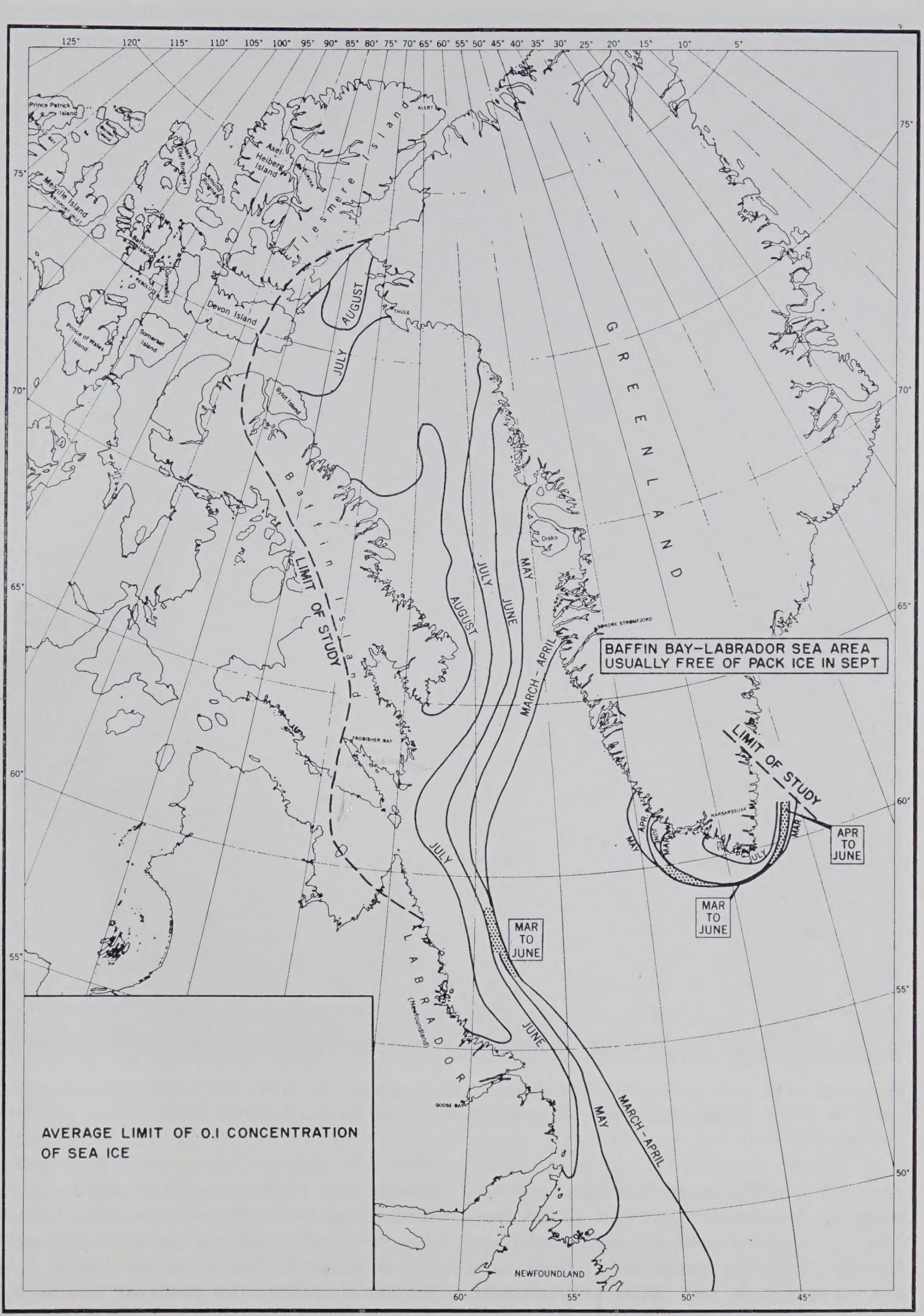

FIGURE 5: Break-up pattern in Baffin Bay–Davis Strait (from Wittmann, 1961).

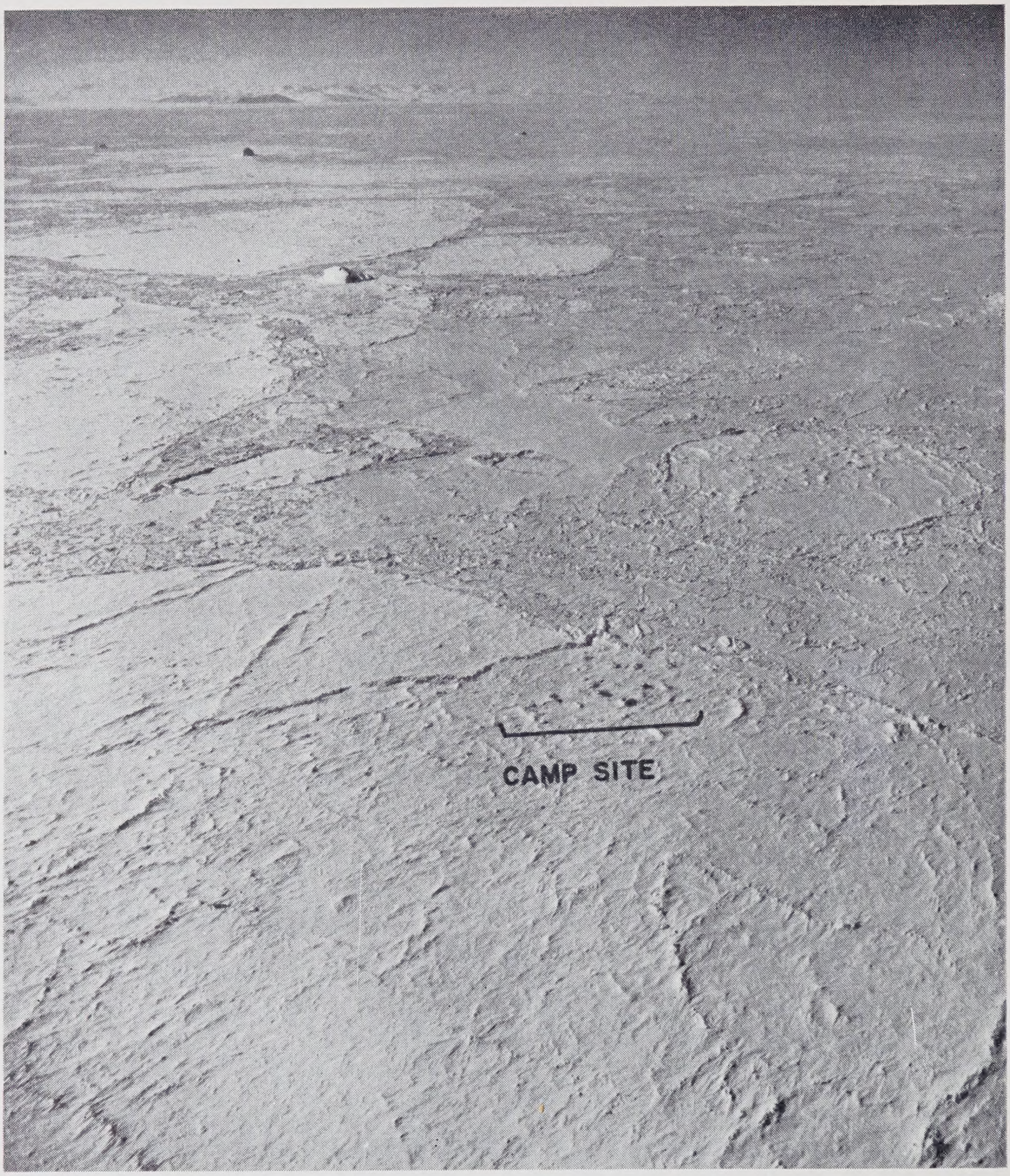

Figure 6: The remains of NP 7 at the time of discovery in April 1961, looking toward the coast of Baffin Island. Note how inconspicuous the camp is. Altitude 2,000 feet. (*R.C.A.F. photograph*)

According to Wittmann[16] few icebergs are observed between Ivigtut and Disko Bay, although quite a number come round Cape Farewell with the storis, and if bergs cannot survive it is not likely a floe could. Even if it did it would still have to chase the retreating pack boundary north and cross the bay at a time of year when everything else had melted. Ice reconnaissance charts for 1960 show that break-up in Baffin Bay followed the pattern in Figure 5 quite closely, and that there was virtually no ice in Baffin Bay after 26 August.[11,12] To catch up with the pack the floe would have to travel at speeds of about 40 miles a day, and even if it could achieve this unlikely feat it would still have to survive the open-water period on the west side of

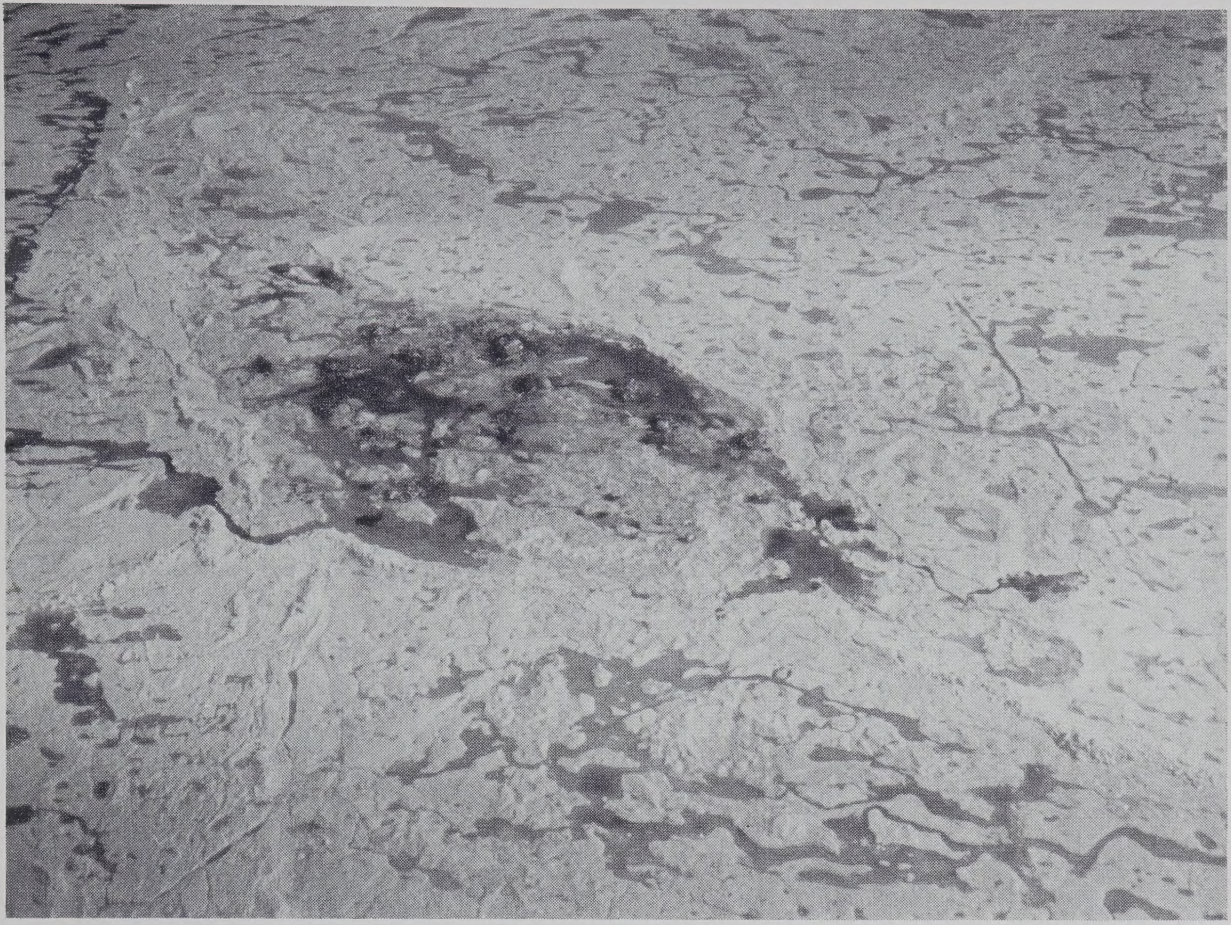

FIGURE 7: The same in mid-July, showing extensive puddling, which has a camouflaging effect. (*U.S. Navy photograph*)

the bay, where surface water temperatures, though lower than on the east side, were still well above freezing, in the order of 3.7° C at the beginning of September.[19]

It therefore seems beyond dispute that NP 7 must have taken the west route to Cape Christian, spending the first winter either in the Arctic Ocean or in the fast ice south of Robeson Channel. From there it presumably drifted out into Baffin Bay rather late in the fall of 1960 along with a lot of other polar ice (to account for the 80 per cent polar ice reported in the vicinity of the station in April), and a number of icebergs and possible ice islands. It is very probable, however, that the ice island reported 40 miles north of Cape Christian in April did not travel with NP 7, but is one which appears in the mouth of Clyde Inlet on Department of Transport ice charts for 17 and 27 September 1960; the dimensions given, 2 by 5 miles, are about the same. An ice island, with its greater mass, would be better able to survive the melt season than a floe. In September 1961 an ice island, possibly also the same one, was seen south of Cumberland Sound, and later broke into small pieces at the entrance to Hudson Strait. The demise of NP 7 was not observed, but there is no doubt that the floe must have melted during the summer. It will be interesting to see whether any remains of huts and equipment turn up on the shores of Baffin Island or Labrador.

One argument that has been used by advocates of the east route is that with so much air traffic up and down the Smith Sound route the station would surely have been discovered much sooner. The evidence does not bear this out. Experienced observers agree that it is extremely difficult to spot an unoccupied station on the ice, and the one who was the first to spot NP 7, W. A. Dotson, claims that he only noticed it because he happened to fly directly over it and his eye was caught by an unexpected shape among the ridges

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(personal communication). Figures 6 and 7 help to demonstrate this fact, showing the camouflaging effect of snow-cover in winter and puddling in summer. Perhaps the most telling argument is that the R.C.A.F. crew who photographed the station, and who were well versed in search techniques, took two hours to find it even though they already knew its approximate position.

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RÉSUMÉ

Une banquise sur laquelle se trouvaient les restes de la 7e station polaire soviétique, abandonnée dans l'océan Arctique au nord du Groënland en avril 1959, a été trouvée au large de la côte orientale de l'île de Baffin en avril 1961. On cherche à savoir quelle route elle a suivie entre ces deux points en se basant sur les renseignements obtenus lors de dérives antérieures, le mouvement des glaces dans l'océan Arctique, les données sur les vents et les conditions normales et actuelles des glaces dans la baie de Baffin et le détroit de Davis.